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Dependence of E-sporadic layer response on solar and geomagnetic activity variations from its ion composition

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Abstract

The aim of this paper is to consider an influence of solar and geomagnetic activity level variations on frequency and stochastic parameters of mid-latitude ionosphere sporadic-E layer. Critical frequency of sporadic-E layer, foEs, relative excess of sporadic ionization over monthly median values, foEs − foEm/foEm, and probability of Es layer appearance, PEs, are considered. It has been found that sporadic-E layer parameters response to solar and geomagnetic activity level variations can be both positive (foEs and PEs values are increase) and negative (foEs and PEs values are decrease). In particular, sporadic-E layers response to solar and geomagnetic activity variations are different depending upon layer intensity. It is suggested that revealed differences may be associated with dissimilarity of the layers ion composition (high-intensive layers are composed from metallic ions and low intensive composed from molecular ions).

Keywords: Solar activity; Magnetic disturbances; E-sporadic layer; Ion composition

1. Introduction

Studies of solar and geomagnetic activity level influence on midlatitude sporadic-E layer parameters were conducted repeatedly during last decades (Baggaley, 1984, 1985; Chavdarov et al., 1975; Whitehead, 1970, 1989). However, results received during the studies conducted are inconsistent. In survey papers (Whitehead, 1970, 1989) it was shown that positive, negative and no correlation of various Es layer parameters with solar and geomagnetic activity level were reported. The correlation of solar and geomagnetic activity level and E sporadic layer may vary with intensity of Es layer, season and time of day. Overall, the relationship between of solar and geomagnetic activity level and midlatitude sporadic-E layer requires further investigation.

2. Data processing technique

A hourly averaged values of foEs parameter for period 1958–1990 obtained at Moscow (56N, 37E), Alma-Ata (43.2N, 76.9E) and Irkutsk (52.5N, 104.0E) stations by vertical-incidence ionosondes were used. A year averaged values of solar spots number, W, and geomagnetic K_p index were also used for solar and geomagnetic activity level description, for the same period.

Analysis of relationship between of solar and geomagnetic activity level and midlatitude sporadic-E layer intensity was conducted for the following parameters: critical frequency of Es layer, foEs, the relative excess of sporadic ionization within E layer over month's median values: δfoEs = (foEs − foEsm)/foEsm and probability of appearance of Es layers with the foEs above selected level, $P(\text{foEs} > f_i)$, ($f_i = 3, 4, 5, 6$ and 7 MHz are used).

As the Es layer parameters are subjected to the influence of various factors which are difficult to take into

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